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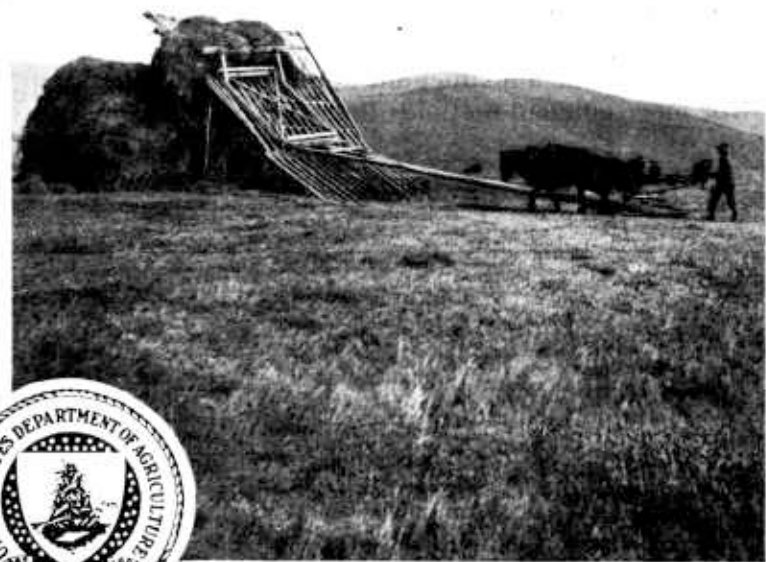
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EFFECTIVE HAYING EQUIPMENT AND PRACTICES

FOR NORTHERN GREAT PLAINS
AND INTERMOUNTAIN REGIONS



IN EVERY HAY-GROWING AREA certain methods and practices in putting up hay have become firmly established.

Some of these are inferior to those in use in similar areas.

This bulletin aims to help ranchers to reduce the cost of haying.

It describes the improved equipment that is used for handling hay in different sections, effective practices that are employed, and the organization and handling of haying crews on different ranches.

It shows what some men are doing to reduce haying costs.

It should be a distinct aid to those who are looking for more efficient methods than they now use.

Washington, D. C.

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EFFECTIVE HAYING EQUIPMENT AND PRACTICES

FOR NORTHERN GREAT PLAINS AND INTER-MOUNTAIN REGIONS

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ESSENTIALS IN LOW-COST HAYING

EVERY RANCHER wants to put up his hay at the lowest possible cost consistent with the desired quality of product. Many are getting very satisfactory results with the methods they now use, but there are others who could materially lower their costs by changing their practices.

In the northern Great Plains and intermountain regions many different methods and practices of putting up hay are followed. Some of these practices have been adopted because of the size of the haying operations, some because of local climatic conditions, some because of the kind of hay raised or quality of hay desired. For economic reasons the method chosen may be the one to use. But frequently through continuous use over a period of time certain practices become so firmly established in a given locality that other practices are considered inferior without being given a reasonable trial.

Primarily, every rancher who would put up his hay at a low cost must—

1. Plan well in advance for the work of haying.
2. Select the proper equipment for his conditions.
3. Organize his crews effectively.
4. Manage the work so as to reduce lost time to a minimum.

The degree of success attained in lowering costs by the utilization of these factors is governed largely by the individuality and personality of the man in charge. Many ranchers should be able to make some reductions in their haying costs by the application of the suggestions in this bulletin.

PLANNING FOR THE WORK OF HAYING

Putting up hay is an operation that, even under the most favorable conditions, requires more constant attention and efficient handling than is usual with most other crops. Both cutting and stacking are limited to a comparatively short period of the season if accomplished without material loss in quality and quantity of hay. Delays in stacking are very costly; the expense of keeping the stacking crew usually continues; the quantity of hay is reduced through excessive drying, shattering, and extra handling; and an inferior quality is likely to result from bleaching, loss of leaves, and improper curing.

For these reasons it is highly essential that the haying equipment be put in proper condition before operations are begun; that sufficient repair parts and tools for making repairs be on hand so that breakages may be repaired with a minimum of lost time; and that definite plans be made for obtaining and caring for the crew so that there will be as little labor turnover as possible during the haying season.

SELECTION OF HAYING EQUIPMENT

The best equipment to use for haying varies considerably according to the kind of hay raised, the yield per acre, the quality of hay it is desired to produce, the topography of the hay land, the quantity of hay that is produced annually, and the distance the hay is hauled to the stack.

MOWERS

Both 5 and 6 foot horse-drawn mowers are in common use throughout the haying areas, and sizes as large as 7 and 8 feet are to be found occasionally. For cutting heavy stands of hay, or where the ground is particularly uneven, the 5-foot size is preferable, but for lighter stands and on smoother ground the 6-foot size is just as satisfactory and has the additional advantage of faster cutting. On some ranches 6-foot mowers are used in heavy hay by having three horses pull them. Occasionally 7 or 8 foot mowers are used with two horses for cutting extremely light hay or with three horses for heavy yields. Tractor-drawn mowers are used where there is enough other work on the ranch to make the use of the tractor profitable. The large acreage of hay that one man is capable of cutting in a day with a tractor mower makes it a very desirable outfit to use.

RAKES

The ordinary self-dump sulky rake is used almost exclusively in the western hay regions. The 12-foot size is common where the hay land is smooth and the 10-foot where it is rough. Some ranchers make a practice of raking in the same direction that the mowers travel, with a rake covering two swaths. The majority seem to prefer to rake crosswise, in which case the size of the rake need have no relation to the width of the swaths. The narrower rake is preferable on rough land because as a rule it does better work under such conditions, is easier on the horses, and there is less strain on the machine.

The side-delivery rake is seldom used at the present time in these regions, principally because of its higher first cost and because it covers only about two-thirds as large an acreage in a given time as the sulky rake. Its use is to be recommended, however, where the hay yield is heavy and particularly if a farmer wishes to produce a very high quality of hay. The side-delivery rake is especially desirable where a mechanical loader is used to load hay on a wagon. Raking hay with a side-delivery rake also hastens the drying process because of the loose windrows which this rake makes.

HAY TEDDERS

Hastening the curing process is a factor that seldom needs consideration under the dry conditions generally prevailing in these regions. But in sections where extra heavy yields are obtained, or where the season is uncommonly wet, there are occasions when it will

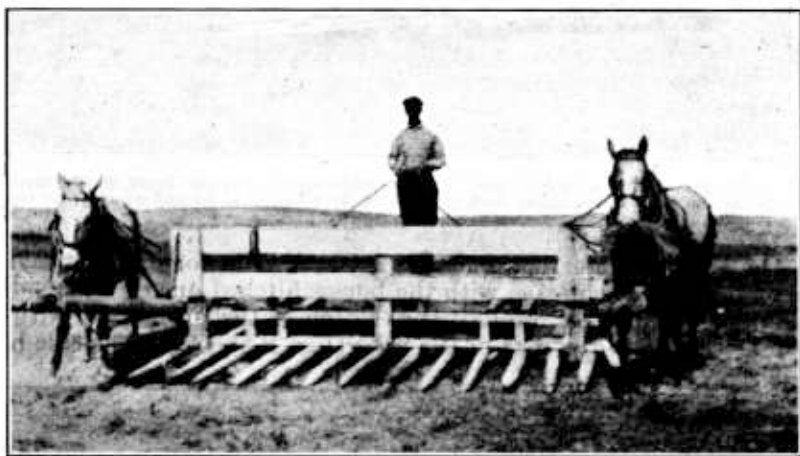


FIG. 1.—The homemade sweep rake used on most ranches in North Park, Colorado, is made of a heavy frame of planks built around a set of mower wheels. The teeth are made from poles. By means of a balance board on which the operator stands the teeth are raised when passing over rough spots in the meadow.

be profitable to use a hay tedder to accelerate curing. Most side-delivery rakes are so constructed that they may be used for tedding hay as well as for raking.

EQUIPMENT FOR HAULING THE HAY TO THE STACK

The common methods of bringing the hay from the windrow or cock to the stack are by means of sweep rakes or by loading the hay on slips or wagons.

For hauls of a half mile or less, hay may be moved more rapidly and cheaply and with less labor with a sweep rake than by any other means. The objections to the use of a sweep rake are that with alfalfa more leaves are lost; where the hay is left in the cock for a considerable length of time the next crop sometimes makes sufficient growth to interfere with the satisfactory use of the sweep; and in some irrigated sections where the ground is dry during the haying season, dragging the hay over bare spots in the meadow

stirs up dust which mixes with the hay reducing its quality and sale value as much as \$2 per ton. Under these conditions it is more desirable to haul the hay on a slip or wagon. For longer hauls than a half mile wagons are usually just as economical as sweeps.



FIG. 2.—Push type of sweep rake. The movable frame near the front of the teeth holds the hay from coming back with the rake when it is backed away from the stacker head

The sweep rake or hay buck, as it is called in some localities, may be of the side-hitch type, with the horses hitched one on each side of the rake that carries the hay (fig. 1), or of the push type, with the horses hitched to the rear of the rake (figs. 2 and 3). The side-hitch



FIG. 3.—A homemade sweep that requires four horses to operate. The sweep carries about 1 ton per load

type is considered more satisfactory where the meadowland is extremely rough, and it is usually possible to haul larger loads with this kind of sweep. The push type has the advantage of working up closer to fences, and the work of the driver is less strenuous than

when using the side-hitch type. In some sections where extremely large loads of hay are hauled, homemade sweep rakes of a heavier pattern are better than those usually built by hay-equipment manufacturers. Figure 1 shows a homemade sweep rake used on most ranches in North Park, Colo., and Figure 3 shows a four-horse sweep rake used on ranches in northern Nebraska.

Hay wagons built especially for hauling hay from the windrow or cock to the stack are common in some sections where it is the practice to stack the hay a considerable distance from where it is cut. These wagons are usually of a very low design with wheels from 16 to 24 inches in diameter.

A hay slip is a low platform on which the hay to be hauled is piled. The simplest form is built of 1-inch boards on top of which are nailed about four 2 by 4 inch cross pieces. This form of slip lasts about three seasons and costs from \$6 to \$7 to build. Another form is built on two runners. (Fig. 4.) In other respects this



FIG. 4.—A load of hay weighing about 1,000 pounds being hauled to the stack on an 8 by 16 foot slip built on runners

slip is the same as the simple form and lasts indefinitely, as new runners can be attached when the old wear out.

Two horses are used to pull the slip which, when loaded, hauls 1,000 or more pounds of hay. Before the slip is loaded a sling or two chains are put on the bed and the hay is piled on top. When the slip reaches the stack the entire load is removed at one lift.

HAY STACKERS

Hay stackers can all be classified under some one of the following types: Overshot, swinging, combination, slide, derrick, cable, and rope.

The overshot, swinging, combination, and slide stackers are better adapted for use with sweep rakes. The derrick, cable, and rope stackers which use slings or forks for elevating the hay are preferable when the hay is brought to the stacks on wagons or slips.

OVERSHOT STACKERS

Overshot stackers (figs. 5 and 20) are used in considerable numbers in every hay section of the region with the exception of North



FIG 5.—The common and widely used overshot stacker

Park, Colo., and possibly some small sections of Idaho and Nebraska. Patented stackers are more common in the overshot type than in any other and as a rule give satisfactory service except in



FIG. 6.—A swinging stacker ready to drop its load on the stack. This outfit takes a load from either side

some sections where large haying operations prevail, and it is customary to load the stackers very heavily. Few of the patented type of stackers are at present built strong enough to stand up where heavy loading is the practice.

SWINGING STACKERS

The swing stacker (fig. 6) is similar to the overshot type except that the rake carrying the hay swings sidewise instead of vertically, the hay sliding off the ends of the rake teeth when being deposited on the stack. The advantage of this type of stacker is that the hay can be deposited at almost any point on the stack, and with some styles of swing stackers it is possible to load from either side at the will of the operator so that the sweep rakes do not interfere with each other as much as when using other types. As many as six and eight sweep rakes are sometimes used with this stacker. The success of this type of stacker depends largely upon the man operating it. In the hands of a good operator it has greater capacity than any other type of stacker in use, but in the hands of a poor operator it is

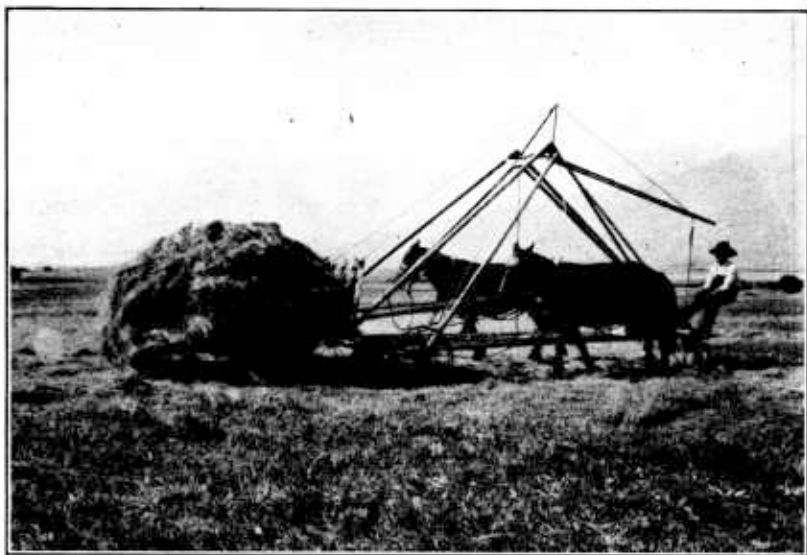


FIG. 7.—A combination stacker bringing in a load of hay. The hay is taken from the windrow by the stacker or delivered to it with a sweep rake

one of the most unsatisfactory types. The patented swing stackers have the same disadvantages as the overshot type—that is, too light construction for heavy loading.

COMBINATION STACKERS

Combination stackers (fig. 7) are less frequently used than either of the two types just described. This type of stacker is mounted on wheels and operates by being driven over the ground. Hay can be deposited on the stacker rake by means of a sweep rake or it can be collected directly from the windrow with the stacker and brought to the stack. An elevating mechanism is engaged when the stacker is about 80 to 100 feet from the stack, and the rake with its load is then lifted as the stacker advances until it is sufficiently high to be deposited upon the stack. The advantages of this type are that no

time is lost in setting when starting a new stack, the hay can be easily placed at any point desired on the stack, and the position of the stacker in relation to the hay stack can be easily changed in case of a sudden change of the direction of the wind. The disadvantages are high first cost, rather low-load capacity, unsatisfactory work on rough or uneven ground, and excessive weight for the operating team, especially if the hay is brought in directly from the windrow.

SLIDE STACKERS

The use of the slide type stacker (figs. 8, 10, and 11) is confined almost exclusively to the vicinity of North Park, Colo., although a somewhat similar stacker is used in certain sections along the Pacific coast for loading hay on wagons. This type was developed for

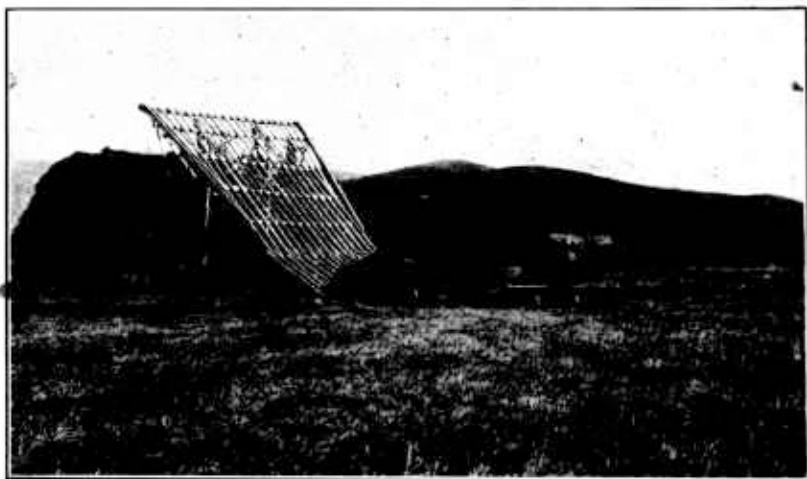


FIG. 8.—A fan-shaped slide stacker which is 18 feet wide at the top and 12 feet at the bottom. The lower 6 feet of the slide is usually constructed of movable sections of 6 or 8 teeth each. When the stacker is moved to a new set, these sections are lifted and shoved back into the body of the stacker. The poles on the slide are continuous from the movable sections to the top. On each side of the slide is a guard rail which prevents the plunger from running off when hay is being pushed up.

stacking wild hay where particularly large tonnages are handled daily by each stacking crew. The stacker is a form of slide built of poles and mounted on skids. A plunger (fig. 9), which completes the outfit, is used to elevate the hay.

Two styles of slide stackers are in general use. One is wider at the top than at the bottom, and the other is the same width throughout. The stackers are constructed of poles from which the bark and all rough spots have been removed.

The lower 6 feet of the slide is usually constructed of movable sections of six or eight teeth each. When the stacker is moved to a new set these sections are lifted and shoved back into the body of the stacker. The poles on the slide are continuous from the movable sections to the top. On each side of the slide is a guard rail which prevents the plunger from running off when the hay is being pushed up.

The plunger, used to push the hay up the slide and onto the stack, is made of a pole about 35 feet long, on the front of which is a heavy frame 12 feet wide, 12 to 16 feet long, and about 3 feet high. To



FIG. 9.—The plunger used with the slide stacker

reduce friction, the frame runs on two wooden rollers. A doubletree is attached on a swivel so that the team can be turned around when the plunger is pulled back from the slide. A pair of small wheels 8 to 10 inches in diameter are sometimes attached to the rear end of

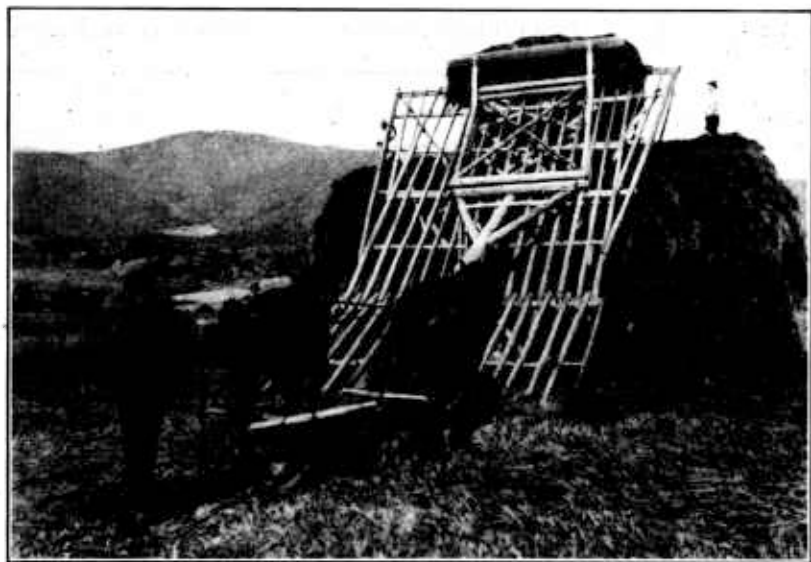


FIG. 10.—A load of hay being pushed over the top of the slide by the plunger

the plunger to prevent its digging into the ground when being pulled back.

Of the two styles, the fan-shaped slide is the better where large stacks are built, as the hay can be thrown to one side or the other of

the stack with the plunger and the stackers save a great amount of work in pulling the hay to the ends of the stack. Most of the sweep rakes used with these stackers are also homemade and of the side-hitch type. (Fig. 1.)



FIG. 11.—Elevating the sections of teeth at the bottom of the slide stacker preparatory to moving to a new set

In stacking with this type of stacker the hay is brought to the base of the slide by the sweep rake, as in Figure 8, and left as it slides off the rake teeth. The plunger, which is in position as in Figure 9,



FIG. 12.—The Mormon derrick, a style in common use in Idaho. The boom pole attached to the upright by means of a band of iron, a steel pin and collar, which allows the pole to turn at the point of attachment. The boom pole is strengthened by a steel cable attached at both ends, while a chain or steel cable attached to the lower end and to the frame holds the pole in position

is then pushed forward by the team. The frame on the front pushes the hay ahead and up the slide. (Fig. 10.) The speed with which the team is driven determines whether the hay will fall at the front or at the rear of the stack. By handling the team properly the

driver can also, with the fan-shaped slide, dump the hay toward either end or in the middle of the stack. Two or three men are usually required on the stack, as this outfit handles hay very rapidly and in large quantities. A heavy team is required to operate the plunger, which, together with the hay, makes up a considerable weight.

Men who have worked with all types of stackers say they prefer the slide for wild hay because the hay then comes over loose and when it drops it falls apart, making the work of stacking easier.

DERRICK STACKERS

Derrick stackers are especially adapted to alfalfa-hay sections where the hay is cured in the cock, but are seldom used in sections where wild and mixed hay is made.



FIG. 13.—The Mormon derrick, common in Colorado. The boom pole is attached solidly to the upright, which is pivoted at the base of the stacker. Plans for this derrick (design No. 2011) and for the one shown in Figure 16 (design No. 2086) can be had on request to the Division of Agricultural Engineering, Bureau of Public Roads, Department of Agriculture, Washington, D. C.

For handling alfalfa with a minimum loss of leaves from shattering and a saving of labor on the stack, the derrick stacker when used with slips (see p. 5) excels all other types.

All stackers of this type are homemade and therefore are usually built to conform to the ideas of individual builders. The Mormon derrick, the style in most general use and perhaps the best, varies slightly in construction in different sections.

Two variations of this style of derrick stacker are shown in Figures 12 and 13. The principal difference in the two stackers is in the method of bracing and attaching the boom pole to the upright pole or mast.

The Wilson style of derrick stacker (fig. 14) is of lighter construction than the Mormon, but because of the cables it takes more men

and time to move it. Other variations of this style are shown in Figures 15 and 16.

In stacking with a derrick the hay is usually transported from the field to stack yard on wagons or slips. (Fig. 4.) Slips are more desirable for short

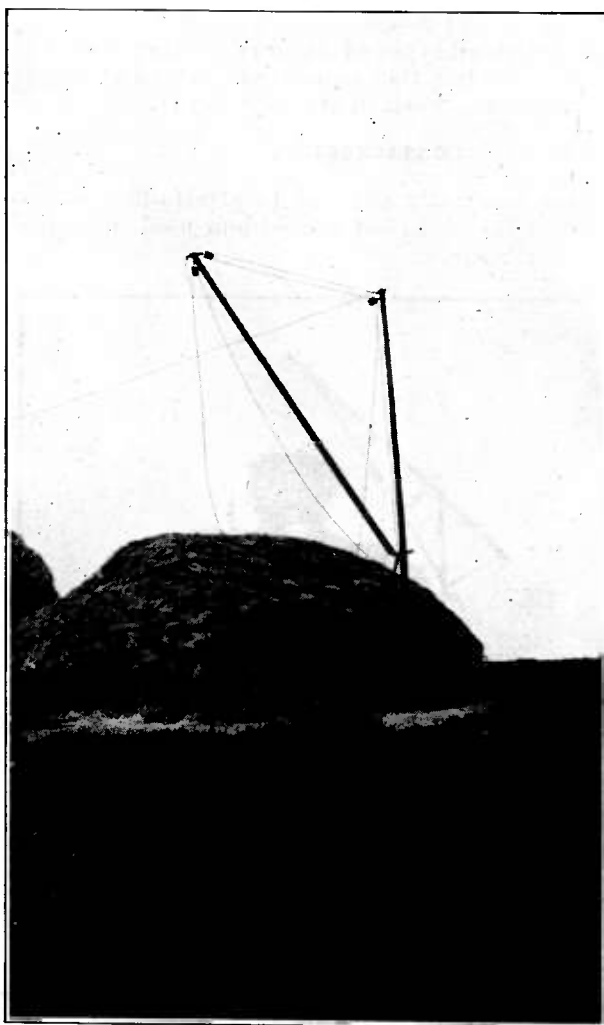


FIG. 14.—The Wilson derrick beside a finished stack. This derrick is held in position by three wire cables attached to the top of the upright pole. The boom pole is attached to the upright by means of a steel collar which permits of two adjustments, namely, the elevation and extension of the boom pole

for short hauls and wagons for long hauls. With the slip, a sling, or two chains (one on each side), are first placed on the bed of the outfit and the hay is then pitched on by one or more men. About 1,000 pounds of hay is handled at a load. When the slip reaches the stack the sling or chains are attached to the pulley and the entire load is elevated to the stack and dumped where the stackers want it.

It is also possible when using a derrick stacker to use a sweep or push rake in delivering hay to the stack. Where this method is employed, the slings are sunk into the ground at the stack until they are flush with the surface. The rake is then driven onto the slings, where the load is left to be

carried to the top of the stack. This is not a very desirable method for handling alfalfa, because more leaves are lost and more dust sometimes gets into the hay than when a slip or wagon is used.

CABLE STACKERS

The cable stacker is used when the rancher wishes to build unusually large stacks in a permanent location each year. It can be used for any kind of hay but is not so desirable for alfalfa if the hay is to be sold, as it may be necessary to mix cuttings to complete the stack, a practice which usually lowers the value of hay.

If the rancher wishes to stack hay in a stack yard close to the feed lots each year, this type of stacker is very satisfactory. The cable stacker can also be used where the stack yard is permanently located in the fields. The important constructional features of the cable stacker are shown in Figure 17.

ROPE STACKERS

Rope stackers. somewhat common in parts of western South Dakota, are used for alfalfa or mixed hay in conjunction with sweep rakes or wagons. Cheapness and lightness are perhaps the only advantages of this type of stacker.

In constructing this stacker three ropes about twice the length of the ordinary stack are fastened to an iron ring. This ring is put over the head of a stake driven into the ground at one end of the stack (far enough away to allow a sweep rake or wagon to drive between) and the three

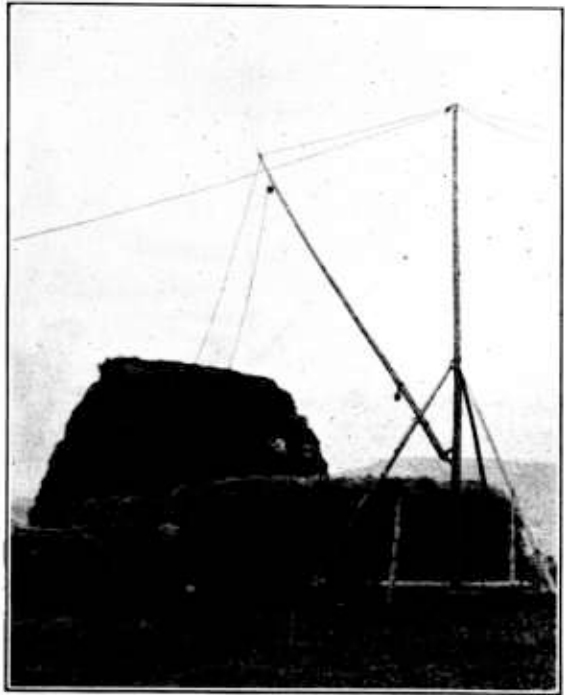


FIG. 15.—A style of Wilson derrier with one adjustment of the boom pole, the lower end of which is solidly attached to the upright pole

ropes are passed over the stack. A sweep rake delivers a load of hay on the ropes and is then backed away. A fourth rope, placed over the top of the stack and the load of hay, is hooked in the ring, which is now lifted from the stake. A team is hitched to the other end of this rope, and when driven ahead the hay rolls up the stack. The other ends of the three ropes are held by the man on the stack, two in one hand and one in the other. If one side of the load rolls ahead of the other the rope on that side is slackened and the rope on the other side is tightened. When the hay is in the desired place on the stack the ropes are released and the hay remains on the stack as the ropes are pulled from underneath. The man driving the team throws the ropes back to the man

on the stack, who arranges them for the next load. If a wagon is used instead of a sweep, the hay is rolled off the rack by means of ropes.

Stacks made with rope stackers are built low at the end where the load is rolled up, and high at the opposite end. At best this is a poor method of stacking, compared with other methods.

HAY SHEDS

In some sections where excessive rains occur or where the snow-fall is heavy, a part or all of the hay is put in sheds or barns. Southwestern Colorado is one such section. Any kind of hay may be stored in this way, as the main purpose is protection from weather to prevent spoilage.

When hay is stored in a shed, wagons are used for hauling the hay from the field. A permanent track and a hay carrier are usually installed in the shed. For unloading the hay from the wagons, slings or forks are used. When the hay is stored in barns it is usually done in the same way, except in

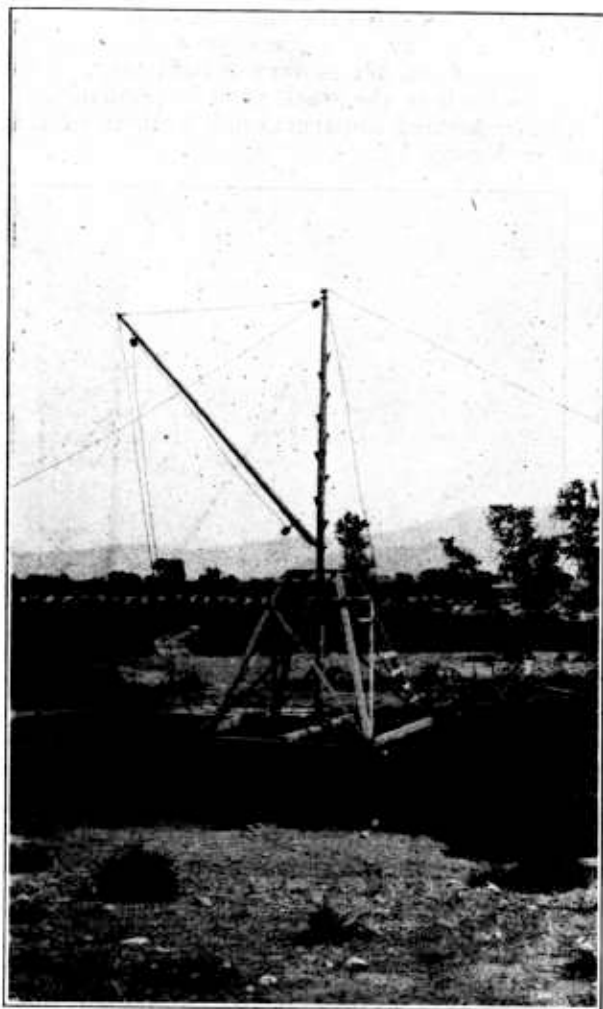


FIG. 16.—Another style of Wilson derrick, the boom pole of which is attached to the upright pole by an adjustable collar. Elimination of the steps on the upright pole would make two adjustments possible. See legend of Figure 13

some parts of Nebraska, where hay barns are constructed as in Figure 18 so that an overshot stacker can be used to put the hay directly into the barn. With this method, sweep rakes are used to bring the hay in from the field to the stacker.

BALING HAY

In some areas considerable hay is baled directly from cocks or windrows. The hay should be thoroughly cured and dry before

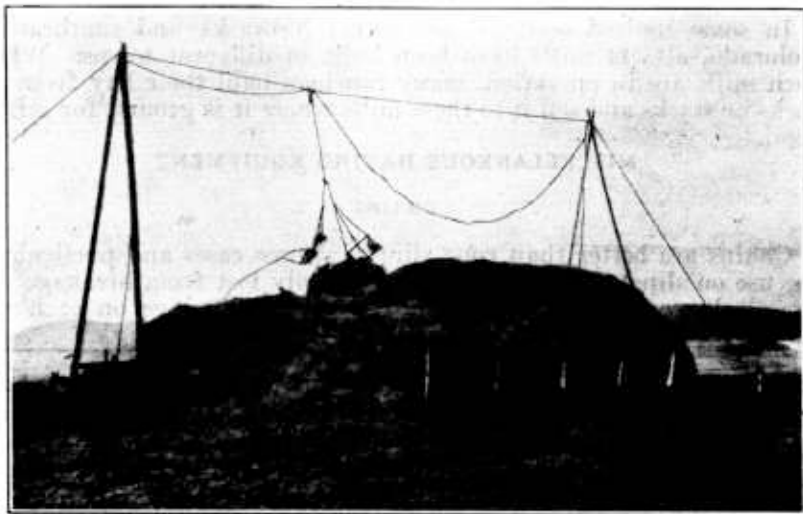


FIG. 17.—A cable stacker with which a sling or fork is used to unload the wagon at the end of the stack. After the hay is elevated, the load is tripped at any point on the stack indicated by the stackers. Stacks up to 200 tons are made with this outfit

baling; otherwise the quality and value will be lowered. Hay baled from the cocks should be stored in such a way as to allow the air to circulate freely around the bales.

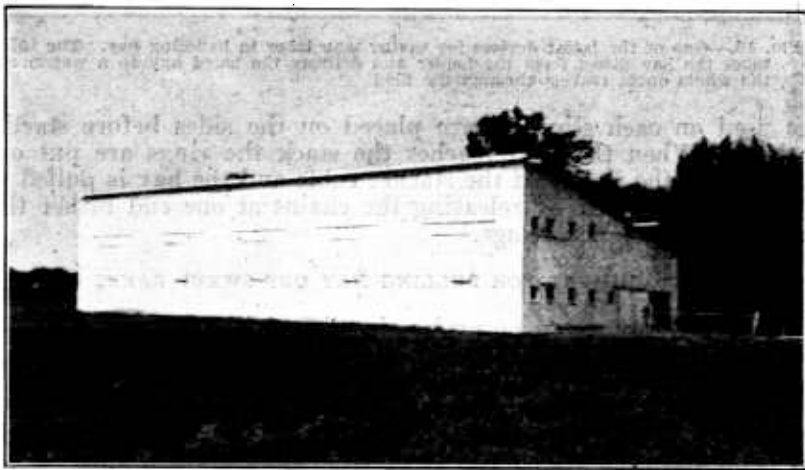


FIG. 18.—A barn for storing hay. An overshot stacker is used to put the hay directly into the barn through the doors at the top

One of the latest devices for saving man labor in handling hay is a combination baler that has been developed in Kansas (fig. 19).

This machine takes the hay directly from the windrow or swath, bales it and delivers the baled hay to a wagon as the outfit travels through the field.

ALFALFA MILLS

In some limited sections, as central Nebraska and southeastern Colorado, alfalfa mills have been built in different towns. Where such mills are in operation, many ranchers haul their hay from the cocks or stacks and sell it to these mills where it is ground for alfalfa meal.

MISCELLANEOUS HAYING EQUIPMENT

CHAINS

Chains are better than rope slings in some cases and particularly for use on slips as they save time ordinarily lost from breakage and practically never wear out. Two chains with rings on each end



FIG. 19.—One of the latest devices for saving man labor in handling hay. The baler takes the hay direct from the loader and delivers the baled hay to a wagon as the whole outfit travels through the field

are used on each slip and are placed on the sides before starting to load. When the load reaches the stack the rings are put over the hook in the pulley of the stacker cable and the hay is pulled up. The load is tripped by releasing the chains at one end rather than in the middle as with slings.

ATTACHMENT FOR PULLING HAY OFF SWEEP RAKES

When using a sweep or push rake difficulty is sometimes experienced in removing the load from the teeth when backing away from the stacker. When the load refuses to slide off the rake teeth it is usually necessary for a man to climb onto the rake and, with a fork stuck into the ground between the teeth, to hold the hay while the team and rake are backed away from the stacker head.

To eliminate this difficulty a light frame made of rough boards (fig. 22) is attached to the rake teeth. The frame fits in between the wheels of the rake with about 1 foot clearance between the ends and the wheels. A board running parallel with the rake teeth is fastened to the bottom of the frame, and this in turn is attached to

the body of the rake by means of a chain. The chain is of such length that when extended the frame is held about a foot back from the ends of the rake teeth. On the back end of the board is attached a pointed iron rod. This rod is attached at an angle with the point towards the rear of the rake. When the rake is empty and is being driven ahead the iron rod drags over the ground, causing the frame to slide to the back of the teeth. When the loaded rake is on the stacker head and the team is backed, the iron rod catches in the ground and holds the frame, which in turn prevents the hay from coming back with the rake. A similar device may be obtained from some hay-equipment manufacturers.

BACKBOARD AND FRONTBOARD

Backboards and frontboards are extensively used with good results by ranchers who put up wild hay with overshot stackers. The front-

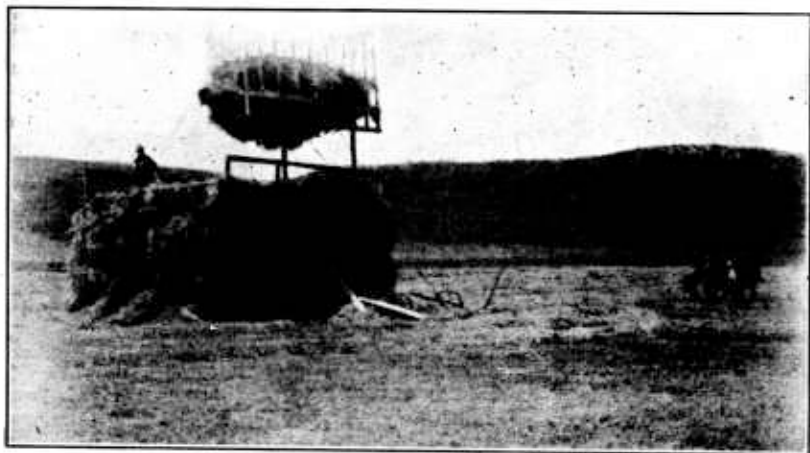


FIG. 20.—The frontboard and backboard used with an overshot stacker in stacking hay. The frontboard is permanently attached to the stacker

board (fig. 20) is attached to the stacker, whereas the backboard (fig. 21) is built on wheels or shoes so that it can be easily moved about the hayfields. By using these devices, the front and rear of the stack can be built without much work on the part of the stackman. All that is necessary is to walk along the sides of the stack and force the hay down so it will shed water. The ends, being open, are made in the usual way. This method of stacking requires only one man on the stack to handle the hay which ordinarily requires two men.

Frames for the backboard and frontboard should be 10 to 12 feet high and about 18 feet long and made of 2 by 6 inch lumber. Smooth, heavy wire is stretched up and down the frame at about 1-foot intervals. Boards may be used in place of the wire but they increase the weight, and breakage is more frequent.

A somewhat similar device, but one that is more clumsy to move, is a wooden box or rack about 16 feet wide, 20 to 24 feet long, and 10 feet high in which the stack is built. The sides and ends of the box are built separately or a side and an end may be hinged together.

When the stack is finished the rack is taken down and folded flat on the ground for moving.

TONGUE TRUCKS

Where the hay land is very rough, tongue trucks are a considerable aid in preventing sore necks on the horses used on both mower and rake. Some mower manufacturers build a specially designed truck to fit their mowers. Many farmers use the truck of a grain binder or grain drill by removing the regular mower tongue and substituting a stub tongue about 5 feet in length to which the truck is attached. For rakes the front running gear of a wagon makes a satisfactory tongue truck, a stub tongue about 6 feet long being substituted for the regular rake tongue.



FIG. 21.—The backboard, the position of which regulates the width of the stack. A stake driven in the ground and to which the caster-wheel in front is attached by a chain prevents the backboard from moving.

SEAT WEIGHTS

Many mower drivers fasten a weight under the seat of the mower to aid in keeping the weight of the tongue off the horses' necks. This is a very good practice and will aid materially in preventing sore necks when tongue trucks are not used.

POWER GRINDERS

Where several mowers are used, the time and labor required to sharpen mower sickles is considerable if a hand-operated grinder is used. There is also a tendency to shorten the beveled edge of the sections when grinding by hand. Such a practice reduces the length of time the sickle will remain sharp and reduces its cutting efficiency in tough grass. In almost every case it will pay the rancher who puts up a large acreage of hay to use a power grinder for grinding sickles.

SUPPLIES AND REPAIR PARTS

In addition to the haying equipment itself, it is very important that the rancher have on hand a supply of those repair parts that are usually needed. Breakages are bound to occur even with the best equipment and delays with haying crews are always costly.

The repair parts most commonly needed for the mower are sickles, sections and heads, cutter-bar guards, ledger plates and clips, pitman rods, pitman rod heads and boxes, and divider boards. If several mowers are used and the meadow land is rough it is also well to have on hand one or two extra tongues and sets of eveners. For the sulky and sweep rakes and the stacker there should be a supply of extra teeth, assorted bolts, an extra stacker rope or cable, and such timbers as are likely to give way at any time during stacking operations. In addition to the repair parts tools should be available for making the repairs, and oils and greases for keeping the equipment properly lubricated. These parts should be kept in a supply wagon that is driven along by the hay crew.

CREW ORGANIZATION AND DUTY

The first thing to consider in planning the size of a haying crew and its organization is the acreage or tonnage of hay that the rancher wishes to handle daily. This will depend to a considerable extent upon the total quantity of hay that is to be made and the number of good haying days that are likely to be available.

It is desirable to get alfalfa cut and off the ground as quickly as is consistent with the equipment and help available in order to interfere as little as possible with the growth of the next crop. With wild hays this factor usually need not be considered. But with every hay crop there is a certain stage of growth at which cutting and stacking will produce the highest quality that can be obtained. The length of this stage varies greatly for different hay crops. With alfalfa it is usually only a few days, whereas with wild hays it may be considerably longer than this.

METHODS OF CREW ORGANIZATION

Two distinct methods of organizing haying crews are in general use. In the first method the cutting and stacking operations are carried on simultaneously with separate crews. In the second method the cutting and stacking is alternated and the same crew does both.

With the first method less equipment is required but a considerably larger crew is necessary to operate efficiently than with the second method. The larger crew is not necessarily objectionable on the larger ranches but may be so on the smaller ones.

The second method has the greatest advantage in those localities where heavy dews or fogs are common during the haying season. Such conditions make it impossible to start stacking until very late in the morning, but it need not necessarily retard mowing operations. By using this method it is possible to set the entire crew to mowing during the forenoons and to stacking in the afternoons when the hay is in the best condition to be put into the stacks. This method requires a greater investment in equipment, but the extra cost is usually

more than made up in savings obtained through more efficient crew management and in producing a better quality of hay.

In sections where it is customary to cure the hay in cocks a somewhat different crew organization is necessary. In such sections the hay is usually cut and then raked almost immediately, and after partially curing in the windrow it is made into cocks by a pitching crew which is separate from the cutting crew. After the hay is sufficiently cured to be stacked, the cutting and pitching crews are combined into a single crew for stacking.

DUTY OF EQUIPMENT AND SIZE OF CREW

The amount of necessary equipment will depend on the quantity of hay that is to be handled daily.

MOWING

The number of acres mowed daily with a given size of mower will vary considerably according to the kind and the yield of hay, the topography of the land, the size and number of horses, the weather conditions, and the length of the work day. On the average, a 5-foot horse-drawn mower will cut slightly over 10 acres in a 10-hour day; the larger mowers proportionally more. An easy way to figure the rate per day is to allow 2 acres daily per foot of width of the cutter bar. A tractor-driven mower traveling $3\frac{1}{2}$ miles per hour will cut from 3 to $3\frac{1}{2}$ acres daily per foot in width. Where several mowers are kept going, the mowing operations can be speeded up considerably by having an extra man to grind the sickles. The camp cook can often be employed for this purpose during his spare time.

Where the mowing and stacking are done simultaneously the rate of mowing will depend entirely on the progress of the stacking crew, as just sufficient hay should be cut in advance to keep the crew provided with a supply of properly cured hay. Because of variations in the yield per acre on various parts of the hay land and in the rate at which the hay will cure on different days, the number of mowers that should be kept going will vary. This should be taken care of by shifting one or more of the rake or sweep teams to an extra mower as necessity requires.

RAKING

The rate of raking varies even more than that of mowing because of a greater variation in the speed the horses walk when pulling a rake. The area raked per day with a dump rake will vary from about 2 acres per foot in width when the horses walk slowly to 3 acres when they are made to walk fast. A side-delivery rake will average from 20 to 25 acres per day.

One rake for each two mowers will usually be sufficient, though an additional rake may be necessary at times for raking the scatterings.

STACKING

The size of the stacking crew may vary without materially affecting the cost per ton of stacking. The principal points to consider in organizing the stacking crew is to provide enough men to put up

the hay in a given time and to plan the duties of each man so there will be a minimum of lost time for each.

The number of men that should be provided for the different duties in stacking will vary, according to the size and location of the stacks, the kind and yield of hay, the type of stacker, and other equipment and methods used.

On ranches where the stock is fed in lots during the winter months, a great deal of time and labor in feeding is saved if a few or all the stacks are built in permanent stack yards adjacent to the barns or lots. Under such conditions, however, the length of haul in stacking is usually considerably greater than where the hay is stacked in the field.

The usual quantity of hay hauled with a sweep at each load will vary according to the kind and dryness of the hay and the size of the horses and equipment used. On the average, a good team of horses will handle from 600 to 1,000 pounds of hay per load and for a 4-horse sweep approximately a ton per load.

The tonnage handled daily by each sweep is governed by the size of load hauled, the kind of stacker used, the length of haul, and the interference of the sweeps with each other, where several are used with the same stacker.

For the average length of haul, the quantity of hay handled with a 2-horse sweep will vary between 20 and 30 tons per day when using slide stackers and between 15 and 25 tons when using other types of stackers.

Where a slide stacker is used, all that it is necessary for the sweep to do in depositing the hay at the stacker is to drive up in front of it and then back away, the plunger being able to pick up the hay and push it up on the stack from this position. With other types of stackers it is usually necessary to give the hay a second push after backing from it the first time. This requires some additional time and lowers the number of loads hauled by the sweep.

If two or more sweeps are being used and the haul is short there may be some interference of the sweeps when depositing the hay at the stacker. These delays will slow up the work of each sweep and should be avoided as much as possible.

Where slips are used the quantity of hay handled daily by each slip is less than with a sweep because of the longer time required to load and unload them. Where enough field or spike pitchers are provided to help with the loading this extra time will amount to very little. The average slip handles from 10 to 15 tons per day where there are extra pitchers to help in loading.

Where wagons are used for hauling, the labor required for loading and the length of the haul is usually greater and the quantity of hay hauled per day by a given size of crew is less than where sweeps or slips are used.

STACKER HELP

Usually one man, or sometimes a boy, is able to take care of the operation of the stacker and the work around the stack when not more than two sweeps are used, but where three or more sweeps are used it frequently pays to have an extra man to help the stacker operator.

MEN ON THE STACK

The number of men to use on the stack depends on the kind of hay being stacked, the size of the stack, the rate at which the hay is being brought in, and the type of stacker used.

Where alfalfa or mixed hay is being stacked and the hay is tangled, one man for each sweep is the rule and in extreme cases two men per sweep may be required. Where wild hay is stacked and frontboard and backboards are used with the stacker, one man can stack the hay from three sweeps.

CHANGING TEAMS

Many ranchers, where sufficient horses are available, have found that a greater acreage of hay can be cut if the horses used on mowers are changed twice a day. Others change teams on all implements except perhaps the sulky rakes.

CREW ORGANIZATION AND MANAGEMENT IN IDAHO FOR ALFALFA HAY

An efficient method of putting up alfalfa hay on an extensive scale is used on the Bruno Sheep Ranch, at Grandview, Idaho, where they have about 500 acres in alfalfa. The crop is cut three times, making a total of 1,500 acres of hay to be cut, cured, and stacked each season. Most of this hay is fed to sheep during the winter. The first cutting is made about June 1 and yields around $2\frac{1}{2}$ tons per acre, the second cutting comes about July 15 and yields around 2 tons, and the third cutting about September 1 yields around $1\frac{1}{2}$ tons, making a total of about 6 tons per acre for the season.

On this ranch the same haying crew is employed throughout the season, which, according to Fred Korner, the foreman, gives better results than hiring new men for each cutting. In 1925 the crew consisted of 14 men who worked about eight hours per day. For cutting, five 5-foot mowers were used. Two 10-foot sulky rates followed directly behind the mowers. After the hay was raked into windrows, seven men put the green hay into cocks, where it cured about six days. This crew cut, raked, and cocked 40 acres of hay daily, all of which was later stacked in a single stack yard.

In 1926 certain changes were made in the raking and cocking crew which lowered the cost of haying and still maintained the same high quality. At present the same five mowers are used. Two side-delivery rakes in place of the sulky rakes follow about one-half day behind the mowers, one goes around the field in the same direction as the mowers go and the other in the opposite direction, thus throwing one windrow on top of the other. The hay in the windrows is then bunched by one sulky rake, thus avoiding the use of hand cockers. In other words, two men with side-delivery rakes and one man with a dump rake are now doing the work of seven hand cockers and two dump rakes, thus saving six men, or \$24, per day.

When the hay is stacked, seven slips built on runners (fig. 4) are used to haul the hay to the stack. Three spike pitchers are in the field to help the drivers load their slips. Each slip makes a round trip every 15 minutes, including about one and one-half minutes

for unloading at the stack. A Mormon derrick (fig. 12) is used for stacking. When the slip comes to the stack the driver and trip man fasten the pulley hook to the two chains on the bed of the slip and the entire load of 1,000 to 1,500 pounds is pulled up on the stack. The derrick team driver and two men on the stack complete the crew. This crew stacks from 80 to 90 tons of hay daily depending on wind and weather.

The alfalfa from each cutting is put in separate butts or stacks. This gives a hay of uniform quality and, when sold, brings a higher price than mixed hay of different cuttings. Hay put up with slips brings a premium of 10 to 20 per cent over that put up with sweep rakes in the same district, as more leaves are saved and there is less dirt in the hay.

Some ranchers have the idea that the Mormon derrick is cumbersome and hard to move, requiring at least two teams. This does not seem to be the case on this ranch, since about 10 minutes are required from the time the stakes are pulled and the stacker moved by one team to a new set until the first slip load of hay has been dropped for the new butt.

Some practices and devices used on this ranch should be of value on other ranches, since they tend to reduce the cost of haying. The old sections in the sickles are replaced with new at the beginning of the season and again when the season is half completed. The mowers are started out each morning with sharp sickles which are changed twice during the day. A power-driven emery wheel is used for sharpening, and when the mowers are in operation one man spends most of his time grinding the extra sickles. A one-half inch iron pipe substituted for the grass board prevents loss of time from breakage. A weight fastened to the under side of the mower seat relieves the horses of some of the weight of the mower. A motor truck is used to take the men to the ranch house for dinner and back again, while the horses are fed and watered in the field.

Two men look over the outfits at the end of each day and any weak bolts or parts are replaced to prevent their breakage and loss of time while the equipment is in use. No stops are made for small breaks during stacking unless absolutely necessary. An extra pair of sling chains are used at the stack so that the slip driver does not have to wait for the return of his chains before starting for another load.

CREW ORGANIZATION AND MANAGEMENT IN MONTANA FOR ALFALFA HAY

On most of the ranches visited in Montana, different sized crews are used for mowing and raking than for stacking. Depending on the elevation, two or three cuttings are made during the season. Except perhaps on some large ranches, the same men are not employed throughout the haying season.

For cutting, one 5-foot mower is used and one 10-foot sulky rake follows a few hours later. The hay is put into windrows, where it cures in one to four days depending on weather and wind. About 10 acres of hay are cut and raked daily.

For stacking, five men are used. The hay is brought into an over-shot stacker by two sweep rakes. Two men stacking the hay and a

man or boy to drive the stacker team complete the crew. From 30 to 40 tons of hay are stacked by this crew in one day.

Best practices call for stacking each cutting separately. On irrigated fields, the first crop makes the best hay for horses, the second crop is the poorest, as it is not so palatable, and the third crop is considered the best for general feeding. When hay is sold the third crop brings \$1 to \$2 per ton premium over the first crop, which in turn brings about \$1 premium over the second.

Most ranches use sweep rakes and overshot stackers, as little attention is given to the quality of hay obtained by using different methods of stacking. Where the flood system of irrigation is used the alfalfa plants practically cover the ground, so that little dirt is picked up by hay on sweep rakes as occurs in Idaho, where the corrugation system of irrigation is used. The quantity of leaves shattered by using a sweep rake is about the same wherever used. Using slips or wagons prevents most of this loss.

CREW ORGANIZATION AND MANAGEMENT IN COLORADO FOR ALFALFA HAY

Most ranchers in and around Greeley, Colo., put up alfalfa hay in the same way. The crop is cut three times. The first cutting, around June 20, yields about $1\frac{3}{4}$ tons per acre; the second, from July 25 to August 1, yields about 1 ton; and the third, around September 10, yields about three-fourths ton. The entire crew for cutting and stacking is usually made up of 11 men. Two 6-foot mowers cut the hay, which lies in the swath one-half to two days, depending on the weather. The hay is put into windrows with a side-delivery or dump rake and then cocked with a dump rake. The hay remains in the cock from four to six days. This crew cuts and rakes from 20 to 24 acres of hay daily. For stacking, three slips are used and one spike pitcher helps the drivers in loading them. The stacker is of the Mormon type. Two men on the stack and a man to drive the stacker team complete the crew. About 30 tons of hay daily are stacked by this crew.

That it is possible to stack as much hay with a smaller crew is illustrated by the performance of a five-man stacking crew on a particular ranch. On this ranch a spike pitcher is not used, as each man loads his own slip. By lowering the hay to the top of the stack at a place where it is wanted before being tripped, one man does all the stacking. As a rule, ordinary rope slings are used with the slips. By using chains, as in Idaho, a saving in time might be effected.

In some localities of the San Luis Valley there are large acreages of alfalfa hay. Usually only two crops are cut during the season, the first around July 10 and the second around August 15, each yielding about $1\frac{1}{2}$ tons per acre.

The usual crew is made up of 10 men. The hay is cut with two 6-foot mowers and is raked into windrows with a 12-foot dump rake, where it remains from four to five days. About 24 acres of hay are cut and raked daily. For stacking two sweep rakes are used together with an overshot stacker. Usually two men are on the stack, but some ranchers, by paying a little higher wages, employ only one man for this work. One man on a dump rake to clean up the scatterings and one on the stacker team complete the crew. This crew will stack from 35 to 45 tons of hay daily.

CREW ORGANIZATION AND MANAGEMENT IN COLORADO FOR WILD HAY

The Big Horn Cattle Ranch at Walden, Colo., well represents the methods used in making wild hay on the ranches of North Park. About 7,000 acres of hay, averaging around 1 ton per acre, are put up yearly. During the growing season the hay is irrigated by flooding.

Six complete crews are employed during the haying season, each crew being made up of 14 men. For cutting, four 6-foot mowers are used in each crew and the hay cures for several days in the swath. After curing, the hay is raked into windrows with two 10-foot sulky rakes. When ready to stack three homemade sweeps are used to haul the hay to the foot of the slide stacker (fig. 8). A man driving the plunger team pushes the hay up the slide and delivers it at a point indicated by the two men on the stack. Two rakes for raking scatterings complete the crew. This crew puts up from five to seven benches (stacks), each of 10 to 12 tons, daily. Usually several of these benches are joined together to make one long stack.

In addition to the field crew a man is employed to grind and sharpen sickles. This man also carries water, drives the lunch wagon to the men in the field, and does other odd jobs. Each morning the mowers start out with sharp sickles which are changed twice during the day. If the mowers get too far ahead of the stackers, one machine is taken off and a fourth sweep put on. At noon fresh teams are put on all outfits with the exception of the dump rakes.

CREW ORGANIZATION AND MANAGEMENT IN COLORADO FOR MIXED HAY

On many ranches in Routt County large acreages of irrigated timothy and alsike clover hay yielding from 3 to 5 tons per acre are grown when conditions are favorable. The most efficient haying crew in this locality is usually made up of nine men.

For cutting, two 6-foot mowers are used. The hay then lies in the swath for about three days, after which it is raked into windrows with a 10-foot dump rake. Three push rakes are used to haul the hay to the stack. Because of the heavy yield, push rakes having four wheels are most frequently used. A slide stacker is commonly used to elevate the hay to the stack. A man to drive the plunger team and two men on the stack complete the crew. This crew puts up about 60 tons of hay daily. Where only two push rakes are used, the crew puts up about 40 tons of hay in nine hours.

CREW ORGANIZATION AND MANAGEMENT IN NEBRASKA FOR WILD HAY

The same system of putting up wild hay is used on most of the ranches in the sand hills of northwestern Nebraska. The size of crews varies slightly, but the tonnage of hay stacked daily varies between 4 and 5 tons per man irrespective of the size of crew.

A common-sized crew is made up of eight men. The hay is cut with two 6-foot mowers and lies in the swath one-half to two days. After curing it is raked into windrows with a 10 or 12 foot sulky rake. Two sweep rakes are used to haul the hay to the overshot

stackers from the windrows. In this area the backboard and front-board (see pp. 17 and 18) are used for stacking so that only one man is required on the stack. A man or boy to drive the stacker team and a man to rake the scatterings completes the crew, which puts up about 32 tons of hay daily. Increasing the crew to 13 men by adding two additional mowers, one sulky rake and two sweep rakes, about 60 tons of hay are put up daily. To handle this quantity of hay, the man on the stack has to be exceptionally good.

A LOW-COST METHOD OF HANDLING STACKED HAY

A method of handling stacked wild hay when feeding is used in the sand-hill area of Nebraska which should be of interest to many cattle feeders of the Great Plains region as it materially reduces the time required to feed cattle compared with other methods now in use.



FIG. 22.—A truck used for hauling from 4 to 5 tons of hay with which it is loaded from the stack by means of wire cables

Wild hay in this area is put up with overshot stackers into stacks of 8 to 10 tons. W. E. Young, a rancher of Gordon, Nebr., uses a special truck and a needle he devised and patented for the purpose, with which he can move 4 to 5 tons of hay from a stack to the truck in a few moments.

The truck (fig. 22) is 10 feet wide by 20 feet long and has four wide-tired steel wheels. Two runners 20 feet long and 4 inches wide, faced with a steel shoe, are placed between the wheels. The wheels carry the entire load when the ground is hard, but if the ground is soft or snow deep the runners carry part of the load when the wheels sink in. Four horses are needed to haul the loaded truck.

The needle used is a steel rod one-half inch in diameter and 20 feet long with a pointed head and an eye (fig. 23). Two wire cables fitted with hooks on both ends, and a short length of wire cable fitted with a claw hook to catch and hold the head of the needle, complete the outfit.

The truck to be loaded is driven close to the side of a stack, which is built about 18 feet long to make the outfit most useful. The needle

is pushed through one side of the stack about halfway up from the bottom and the cable hooked into the eye (fig. 23) of the needle and attached at the other end to a ring on the side of the truck nearest the stack. The needle and cable are then pulled through the stack, and when the cable is tight the free end is thrown over the top of the stack and across the truck.

The needle and cable may often be pulled through the stack by hand, but when there is difficulty a team will pull it through easily by using the claw hook and short wire cable. The second cable is then drawn through the stack on the opposite end. The four horses are then hitched to the two cables by hooking the ends



FIG. 23.—The end of a needle which has been pushed through the stack showing the eye and the wire cable. The cable is hooked to the needle, pulled through the stack, and then thrown over the top and across the truck

into a ring on the doubletree, and the upper half of the stack is rolled over on the truck. The load may be bound down by attaching the free ends of the cable to the truck, thus preventing the load from slipping off, but this precaution is not necessary when hauling over smooth ground. On reaching the feed lot the driver shoves the hay off with a fork on each side as the truck moves along. Under ordinary conditions only 15 minutes are required to load the truck with 4 or 5 tons of hay. Mr. Young states that during the winter of 1924-25 with this outfit he fed 400 head of cattle 4 tons of hay in one hour, which included loading the truck, hauling, and distributing the hay in the feed lot.

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